PART I

1.0 Introduction I

The WLM-L11G protects customers' investments over the long term. Buffalo's new WLAN product, WLM-L11G, is the IEEE802.11b-based access point (AP) with room to grow to IEEE802.11a or IEEE802.11g, depending on the user's needs. The Buffalo solution offers simultaneous communication on both 5GHz and 2.4GHz bands without annoying bottlenecks. High reliability, manageability and standard Buffalo features are integrated in the product and will assure easy management and high quality signal communication. The WLM-L11G's versatility will allow indoor as well as outdoor (station-to-station) applications.

1.1 Summary of Features

- Expandable from 802.11b to higher data rates such as 802.11a or 802.11g
- Updated and extensive security (128-WEP, 802.1x/EAP, TKIP, RADIUS)
- Network integrity (fault tolerance, link integrity, spanning tree)
- Network load distribution (load balancing, repeater, WDS)
- Interoperable with IEEE802.11b Wi-Fi™, compliant equipment
- Roaming, best access point selection and traffic filtering (IP and MAC address)
- ESS-ID "any" rejection option
- Configurable through web browser
- Command line setup by Telnet and/or a serial console
- Downloadable firmware update
- Long range (diversity antenna) and even longer range (with additional outdoor antenna)
- Bridge to multiple networks, or AP-to-AP communication
- Outdoor point-to-multipoint broadcasting
- Repeating function support
- Power over Ethernet, PoE, for convenient power supply
- Auto MDI/X port for any CAT5 type cables
- Other network administrative functions

2.0 Package Contents

The AirStation™ WLM-L11G package consists of the following items. If any item is missing, please contact the seller.

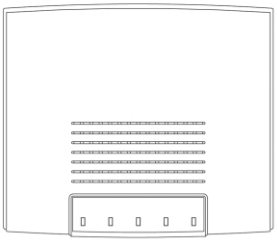
1. WLM-L11G Access Point
2. AC adapter
3. Power cable
4. Mini-DIN 8 pin-Dsub 9 pin cross serial cable
5. WLM-L11G Manual
6. AirStation Driver CD
7. Warranty and Registration card

3.0 System Requirements

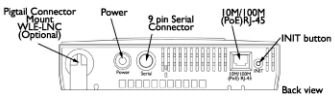
The system requires IP routing externally. The TCP/IP protocol must be loaded on each PC used in the system. Other requirements:

- One broadband Internet connection via an existing LAN system.
- A router, a hub or a switching hub
- UTP network cable with RJ-45 connector
- Internet Explorer 4.0 or higher, or Netscape Navigator 4.0 or higher

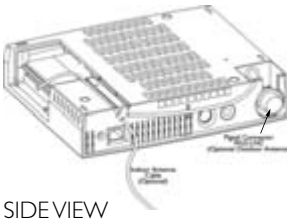
4.0 Product Views



TOP VIEW



BACK VIEW



SIDE VIEW

5.0 Features

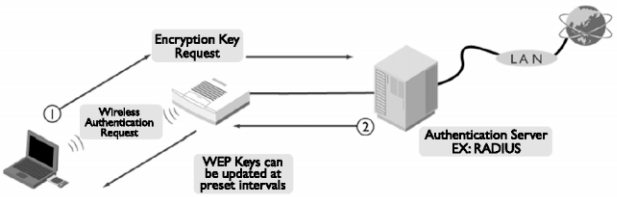
The Buffalo AirStation Intelligent access point provides the features necessary in today's business environment, with a high level of reliability and security. Use of these features along with VPN will allow the user to have the highest security a WLAN can offer. For minimum security measures Buffalo recommends the use of 128bit WEP and registering client MAC addresses in the AirStation. Some of the noteworthy features are shown below. Other features are listed in Section 9.

5.1 Security Features

The WLM-L11G model provides three levels of security: authentication, privacy and access authorization. The first level consists of checking and issuing the user's authentication by EAP and 802.1x, similar to the Windows XP authentication process.

The second is encrypting user's data with WEP, TKIP or MIC encryption algorithms. Finally, granting the data access privilege only after the user's authentication is offered by exchanging a specific key under the 802.1x method.

Fiture 5.1 Security features.



5.1.1 Authentication

The IEEE802.1x security method imposes access port control at the access point level for each user communication signal. The EAP function in a client PC performs an authentication login to the authorization server, such as RADIUS, through the WLM-L11G access point when the link is established and before data transmission takes place.

EAP – Extensible Authentication Protocol is a function in a client PC, which initiates the authentication login to a network through an AP such as the WLM-L11G. When the client is approved and authenticated for a communication session, the client receives a unique WEP key from a network security server such as RADIUS.

802.1x – Known as .1x, this is the key exchange standard used between a client and an AP for the user's authentication process. Configuration for a large network is much easier since individual WEP settings are no longer required for each client. In addition, access management is performed easily in the RADIUS server environment, making this feature valuable for network administration.

5.1.2 Privacy

Several encryption algorithms can be used to mix with the data for protecting privacy. WEP is the encryption method adopted in the current WLAN industry. Because WEP was found to be vulnerable, WEP will be replaced with a more powerful Advanced Encryption System (AES) in the future so that even higher levels of security will be available. Meanwhile, use of TKIP and MIC can be an alternative to AES.

WEP – Wired Equivalent Privacy is a security method for wireless networking using the RC4 encryption algorithm. WEP consists of two elements: an Initialization Vector (IV) of 24 bits that describes the packet header information, and current data of 40 or 104 bits. For example, a 128bit WEP key means a 24bit IV plus a 104bit data encryption and they are encrypted separately.

TKIP – Temporal Key Integrity Protocol is an advanced encryption method using the RC4 algorithm. Instead of using the sequential IV, a random IV will be used, and the IV key definition will be updated regularly at a preset time interval.

MIC – Message Integrity Check is an encryption method used to prevent a hacker from changing the data content. An encryp-

tion algorithm and bit checksum at both the sender and receiver ends are used to check for alteration of the packet content.

5.1.3 Access Authorization

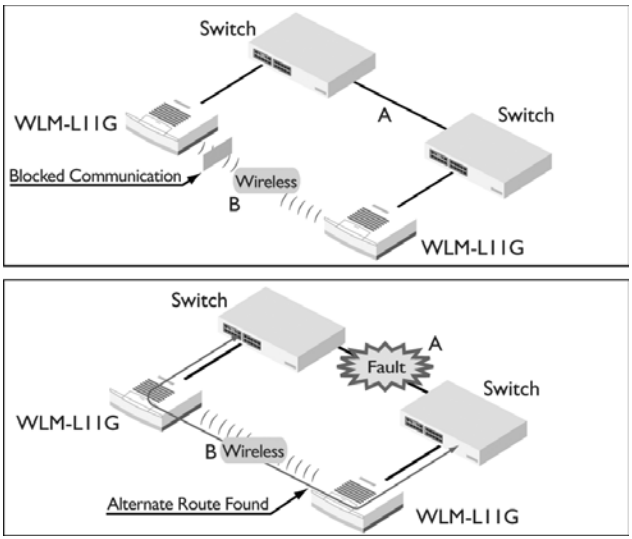
When the client is approved and authenticated for a communication session, the client receives a unique WEP key from the security server, such as a RADIUS server, under the 802.1x/EAP authorization specification. A new WEP key is issued for each connection, thus improving security, and the WEP key is updated regularly at a preset time interval. Another method to screen out unauthorized users is MAC address filtering.

ESS-ID – Extended Service Set Identification is a type of unique identifier applied to both the AP and the wireless client, as well as each information packet. It allows APs to recognize each wireless client and its traffic. This option, however, does not provide sufficient security for today's wireless networking environment. If the ESS-ID is set to "any" or "null", anybody can connect to the AP. Also, Windows XP automatically displays the ESS-ID of the AP when a client receives a "beacon." This is because APs transmit their ESS-ID periodically and these transmissions can be easily intercepted.

MAC Address – Media Access Control address is a hardware address that uniquely identifies network hardware such as a wireless NIC or an AP. It is easy to access a network with a stolen wireless NIC. Although it is used as the top level filtering, it is not secure enough, because MAC addresses can be duplicated by non-registered users.

5.1.4 IBSS Security

IBSS – Independent Basic Service Set security is used for ad hoc communications like the point-to-point protocol (PPP) method. WEP and MAC address filtering can be used at this point.



Fiture 5.2.1 Improved Fault Tolerance

5.2 Integrity Features

5.2.1 Improved Fault Tolerance

A company's Intranet is an important corporate communication backbone, so the WLM-L11G AP offers features for network stability, which is achieved through the system's redundant switching function, activated automatically in the event of faults. The auto system redundancy provides the network reliability necessary for mission critical applications.

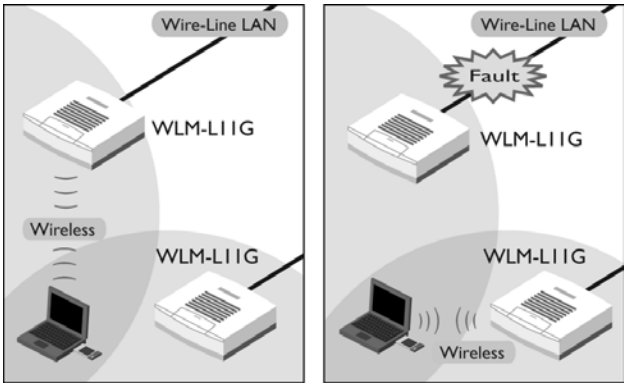
5.2.2 Link Integrity

When multiple access points use the same frequency for roaming, they tend to interfere with each other. The WLM-L11G AP automatically switches all PCs under the same wireless ESS-ID to another available access point if the current access point becomes disconnected form the network, thus preserving the connection and throughput.

5.2.3 Spanning Tree (IEEE802.1d)

Network looping often results in repeated packet transmission, which causes overloads and interruption of communications. The

Figure 5.2.2 Link integrity



Spanning Tree in a network loop disconnects one of the links, rerouting the traffic in the event of failure, avoiding packet sending repetition and increasing network stability.

5.3 Network Load Distribution Features

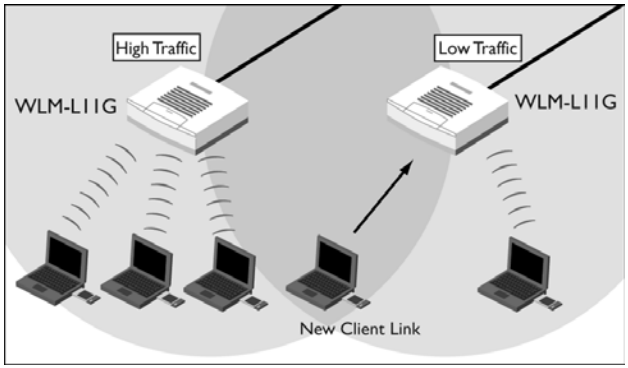
5.3.1 Load Balancing

This feature enables automatic selection of an available access point with the least load among multiple APs. It allows easy roaming, and the network stability can be increased significantly through even distribution of the traffic load.

5.3.2 Repeater

The WLM-L11G AP can act as a repeater to other APs. This feature provides a solution for clients operating in the "dead zone," where signal does not reach. Combination of this function and add-on antennas can offer extended range.

Figure 5.3.1 Load Balancing



5.3.3 WDS – Wireless Distribution System

WDS is used to create access-point to access-point communications when a CAT5 cable cannot be used or is unavailable. Similar to repeating, it is primarily used to extend the reach of the WLAN. Displaying the name of the available AirStation while roaming is also possible.

5.4 Network Administration Features

5.4.1 SNMP – Simple Network Management Protocol

The WLM-L11G AP supports SNMP. Each unit acts as an SNMP agent so that the network connection status and configuration information may be accessed remotely through the SNMP manager, which enables centralized traffic and fault monitoring.

5.4.2 Syslog

This feature allows sending a copy of the system log to the Syslog server automatically. The log contains information on the operating status of each device, which enables real-time monitoring of operational data, fault data, user login data and other such information. Although the WLM-L11G model supports the Syslog server as a part of its administrative utilities, it is possible to use additional off-the-shelf Syslog server software.

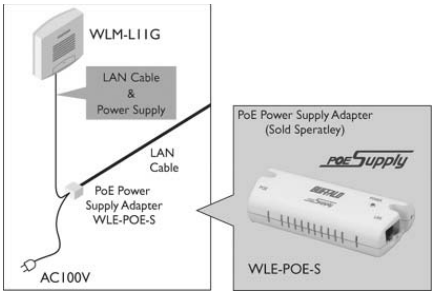
5.5 Easy Support Features

Buffalo periodically releases new firmware updates for AirStation products. The firmware is easily uploaded to the AirStation from a PC. Look for new firmware releases on the www.buffalotech.com website.

6.0 Support Functions

6.1 PoE - Power over Ethernet

PoE based on the IEEE802.3af specification, draft 2.0, provides power in a CAT5 cable, thus eliminating the need to use a separate power supply cable. It must be used with Buffalo's supply adapter WLE-PoE-S (sold separately) as shown below. With PoE, the user can locate a WLM-L11G anywhere without the need for a power outlet nearby.



6.2 Environmental Resistance

The WLM-L11G AP's high durability design allows resistance to environmental conditions like temperature changes. Since it is less susceptible to environmental change, it is suitable for warehouses, public areas and other locations where temperature control is not available. Optional dust-proof and waterproof casings are available.

6.3 Upgradeable Firmware

With Buffalo's firmware upgrade utility tool, updating the firmware will be simple.

6.4 Diagnostic Support

The WLM-L11G provides tools to monitor and methods to correct its wireless operations. Some of these tools are device status, packet status, wireless PC information, ping test, log information and re-initialization of parameters.

PART II

7.0 Client Configuration

7.1 Introduction II

This chapter provides general information about:

- Basic Setup
- Time Setup
- Administrative Managing
- Bridging Setup
- Routing Setup
- Packet filtering Setup
- Limiting wireless client number
- WDS (AP-to-AP) Setup
- Wireless Setup

Explanations for each parameter and details of how to use the parameter are described in the next chapter. Connecting and setting up the access point for accessing the Internet quickly are the objective of this chapter.

7.2 Setup Preparation

The following parameters must be known before setting up the WLM-L11G Intelligent Access Point. If you do not have these, you should consult with your IT personnel.

- WLM-L11G's ESS-ID
- WLM-L11G's system name or location name
- WLM-L11G's IP address. If you plan to use DHCP, this is not necessary.
- WLM-L11G's wired side MAC address. Check the label on the back of the WLM-L11G.

7.3 Setup Overview

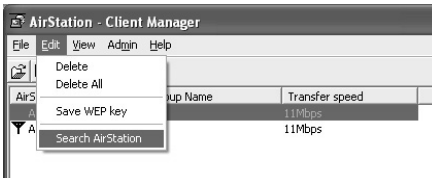
A general setup process is shown below. Special setups for security, filtering and others will be explained in later sections.

1. Connect the cables to WLM-L11G based on the wiring instructions. It is possible to use a straight cable to connect the AirStation directly to your PC. In this case you need some type of Terminal Software to set up the WLM-L11G.

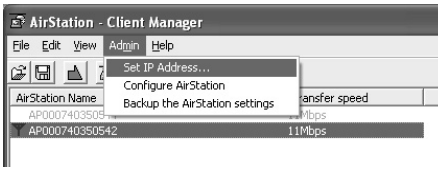
2. The PC must have a valid TCP/IP setting. For the TCP/IP setup or to check it, please refer to the instructions for your OS (the default IP and subnet address of the WLM-L11G is 1.1.1.1 and 255.255.0).

7.4 Installation of the Client Manager

1. Insert the AirStation Driver CD into the CD-ROM drive.
2. Start the Install wizard. If the wizard does not start, double click the Ezsetup.exe file in the AirStation Driver CD. Install the Client Manager.
3. Click Start and select Programs / AirStation Utility / Client Manager to open the Client Manager. The setup PC must have a valid IP address of its own.
4. Select Edit / Search AirStation to look for the nearest AirStation. Highlight the WLM-L11G.



5. After finding an AirStation, select Admin / Set IP address.



6. Either enter the IP and Subnet Mask address in the boxes or select DHCP.

7. Leave the Password box empty. Click OK.
8. IP address setup is complete.

7.5 Setup Screen

1. Highlight the WLM-L11G, click the "Admin" button, then the "Configure AirStation" tab to open the setup screen.
2. Select the language you want to use. English and Japanese are available.

7.6 Input Parameters Through the Client Manager

1. Click the "Advanced Settings" box to open the next page. Once WEP in the AirStation is configured, the wireless Client PC requires WEP for communication. Research for the AirStation in Client Manager. When the WEP screen appears, enter the WEP code exactly as entered in the AirStation, click OK to reestablish communication with the AirStation.
2. In the password page, enter the following information:

   User Name: root

   Password: [leave blank]

   Click OK.
3. Click the "time" menu on the left (menu section) to set the current time. Click Set.
4. Click the "Wireless" menu on the left; then click the "802.11b" menu.
5. Enter appropriate ESS-ID and channel number. Click Set.

   ■ Note: ESS-IDs are case sensitive, up to 32 alphanumeric characters in length.
6. Click the "Security " menu then click the "802.11b" menu on the left.
7. Select WEP Enable box. Enter appropriate WEP key on line 1. Click Set. Click Set again. Once WEP in the AirStation is configured, the wireless Client PC requires WEP for communication. Research for the AirStation in Client Manager. When the WEP screen appears, enter the WEP code exactly as entered in the AirStation, click OK to reestablish communication with the AirStation.
8. Click the "Management" menu on the left.

9. If you want to use the SNMP function, check "Use" and input the WLM-L11G's location, administrator information and community names. Click Set.
10. If the WLM-L11G is operated in a large network environment, using a pre-determined name identification system may be recommended, to help identify the WLM-L11G easily. In order to set the name, click the "Basic" menu to open the basic setup page. Type an appropriate name in the "AirStation Name" box. Click Set.
11. On the same page, you may opt to obtain the IP address from the DHCP server or enter a static IP address manually for the access point. If you are given a default gateway IP from your ISP, input that address. If it is not given to you, leave the box empty. Click Set.

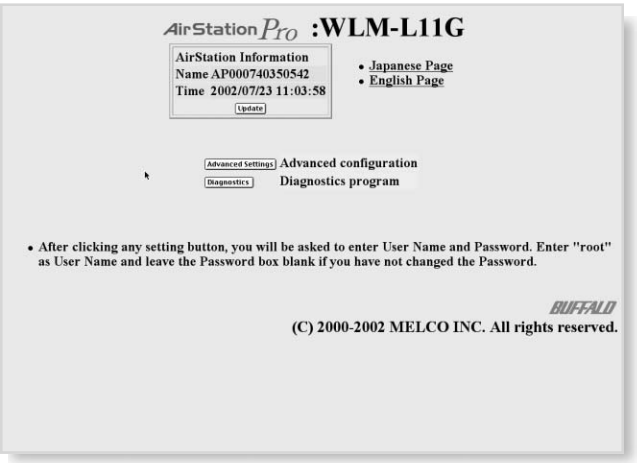


Figure 7.5 Setup Screen

7.7 Input Parameters Through a Wired PC, Terminal Software

1. Use the serial cable provided to connect the WLM-L11G to the PC's COM port.
2. Start the Hyper Terminal software included in the Windows OS. Hyper Terminal is a standard software in Windows but it is possible to use any other off-the-shelf software.

   ■ Note: If the AirStation is already connected by Telnet or Client Manager, you cannot log in from the terminal software.
3. Setup the terminal as follows:

   Baud rate: 57600

   Data bit: 8

   Parity: None

   Stop bit: 1

   Flow Control: None
4. When the "Apxxxxxxxxxxxxx login" prompt appears, login the WLM-L11G by "root".
5. Set the WLM-L11G's time by using "date" command: Setup date year/month/date (use two digit number for the month and the date, Example: "set date 2002/03/27")
6. Set the WLM-L11G's ESS-ID by using "essid" command. Airset essid xxxxxxx (ESS-ID is defined by up to 32 alphanumeric characters. The default value is 12 digits. You can reset the ESS-ID to the default value by using "airset essid_default" command.)
7. Set the WLM-L11G's wireless channel. Use "airset channel xx" command. Select one number from 1~11. The default number is 11.

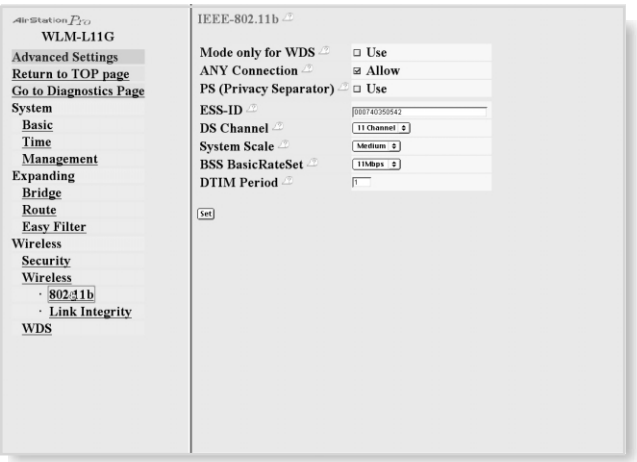


Figure 7.6.6 Security Settings

8. Set the WLM-L11G's WEP. Use "airset wep xxxx yyyy zzzz" command. Xxxx is the key type (40 or 128bit) and yyyy is the key index number and zzzz is the actual key as shown below.

   Keytype: Key – 40bit WEP

   Key128 – 128bit WEP

   Key index: The index number of the WEP to be used, select one from 1~4. The default is 1.

   Key: "text" + 5 blank spaces + 5 letters or 10 digits hexadecimal (for 40bit WEP) or 13 characters or 26 digits hexadecimal (for 128bit WEP)

   ■ Note: the text must be used with " " mark.s. Examples:

   Airset wep key text "skey5"

   Airset wep key a3d58bb632

   Airset wep key index 1 text "skey5"

   If you want to clear the WEP key use: Airset wep keytype clear (the keytype is explained above).

9. Set the WLM-L11G's system ID name. Use the "set apname xxx" command. Xxx is a numeral of up to 32 characters. An example is: Set apname AirStation01. If you need to re-set the device to default name use the following example. Set apname _default.

10. Set the WLM-L11G's IP address. Use "ip address lan0 assigned_ip" command. Assigned_ip: The IP address assigned by your ISP.
    Examples:

    Ip address lan0 192.168.100.60/ 255.255.255.0 – manually input the IP address and Netmask.

    Ip address lan0 dhcp – use the DHCP server

    Ip address lan0 clear – clears the IP address

11. Set the WLM-L11G's default gateway. Use "ip defaultgw gw_ip" command. Gw_ip is the assigned gateway IP. Example: gw_ip 192.168.0.10

Figure 7.6.9 SNMP Function

Figure 7.6.11 DHCP and manual IP configuration

7.8 Input Parameters Through a Wired PC, Telnet Software

The WLM-L11G setup can be performed by using Telnet software similar to the Terminal software above.

In order to bring up the setup page:

1. Connect the supplied serial cable to the AirStation and the PC's COM port.

2. Select Start / Run.
3. Input "Telnet <WLM-L11G's IP address>" in the file name and press "Enter". The IP address can be identified through the Client Manager or Terminal Software setup screen.
4. When login prompt appears, enter "root" as a default login name.
5. Input "?"/press "Enter" to view list of commands.

PART III

8.0 Detailed Configurations

8.1 Introduction III

Although your AirStation will work fine in most network environments, you may wish to explore the advanced options. This chapter explains each parameter in the setup screen.

8.2 Basic Settings

Basic Settings includes the following parameters:

AirStation Name
Connection type
IP address
Default Gateway
DNS Server

8.2.1 AirStation Name

A unique name can be set for your AirStation in order for clients to recognize it. It identifies each access point when multiple access points are present. Although it is not necessary to set this parameter, it can be useful. Once it is set, the name will be shown at the top of the initial setup screen.

8.2.2 Connection type

The following options are possible for the wired LAN port setting:

10 Mbps Half Duplex
100 Mbps Half Duplex
Auto

If the port on the LAN hub is set to Full Duplex, set the WLM-L11G to Auto.

8.2.3 IP Address

If you do not use a DHCP server on your network, you have to assign an IP address manually. A specific IP address should be obtained for this. You can use DHCP by selecting "auto IP assignment from DHCP Server."

8.2.4 Default Gateway

A default gateway IP should be assigned to the AirStation. If the gateway IP is unknown, leave the box blank. If "Auto IP assignment from DHCP Server" is selected, the gateway IP will be assigned automatically.

8.2.5 DNS Server

Input the IP address of the server to be used by the WLM-L11G for DNS resolution. If DNS is not used, leave blank.

8.3 Time Settings

Input the correct time manually or input the NTP server on your network. Using NTP Server: Check the "Use" box. Specify the NTP server name, check interval, and time zone.

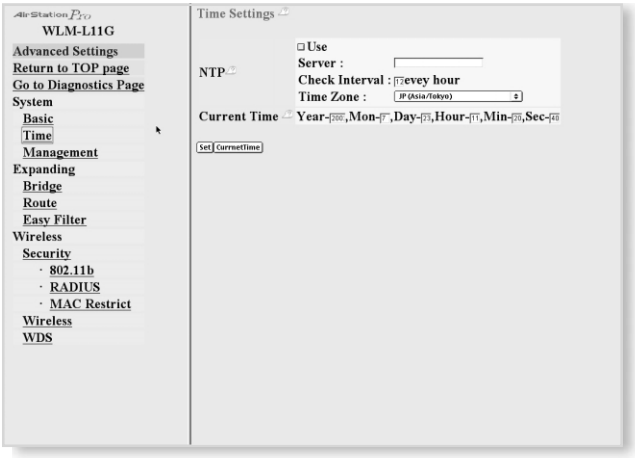


Figure 8.3
Time settings

8.4 Management

Management Settings includes the following parameters:

Password

Setting Interface

Logging Settings

SNMP Agent Settings

Figure 8.41 Passwords

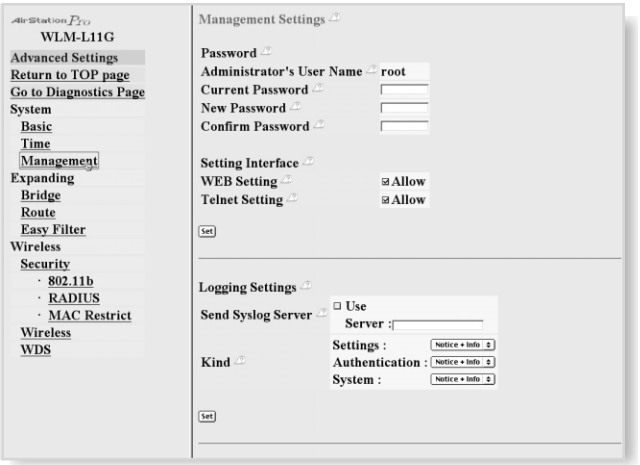


Figure 8.4.3 Logging Settings

8.4.1 Password

The user ID is "root". The default password is blank -- no password.

To input a new password:

- Enter the password in the "New Password" field
- Re-enter the password in the "Confirm Password" field

If you are changing an old password, you must enter the old password in the "Current Password" field also.

8.4.2 Setting Interface

Configuration of the WLM-L11G via a web browser (including Client Manager) or a Telnet session may be enabled or disabled here. A wired session via the serial port and terminal software may be used to configure the WLM-L11G if WEB and Telnet are disabled.

8.4.3 Logging Settings

This enables reporting to the syslog server. Check the "use" box if you want the system logs to be sent to the log server. The setup for the log server should be found in the syslog's manual. The following parameters can be configured: Log type, Log level, Notice, Information content, Setup record (AirStation setup record), Login recognition (includes Radius) and System.

8.4.4 SNMP Agent Settings

Enabling the SNMP agent function allows the following:

Access from the SNMP manager. Access the WLM-L11G local MIB information (through a web browser) such as the WLM-L11G's location, the WLM-L11G's administrator, and the SNMP community where the WLM-L11G belongs.

When MIB file is accessed, the following object ID (the ID which indicates information to be included in general network devices) or the number will be used.

System(1)=General administrative information

Interfaces(2)=PHY interface information

IP(4)=Whether IP is working or not.

Icmp(5)=Whether ICMP protocol is working or not.

TCP(6)=Whether TCP protocol is working or not.

UDP(7)=Whether UDP protocol is working or not.

SNMP(11)=Whether SNMP is working or not.

The number that corresponds to the ID will be displayed. If you want to assign a different value, input the desired value and click "Set."

8.5 Bridge Settings

Bridge settings includes the following parameters:

Spanning Tree

Bridge Priority

Forward Delay

Hello Time

Max Age

Aging Time

Port Priority

Path Cost

8.5.1 Spanning Tree

This function is used to prevent data from being circulated infinitely when the network is a loop type.

8.5.2 Bridge Priority

The priority of the bridge can be set anywhere between 0~65535. The value depends on how you form the Spanning Tree. The primary routing bridge within the Tree must be assigned the minimum value. An arbitrary value can be assigned to other bridges. The default value is 32768.

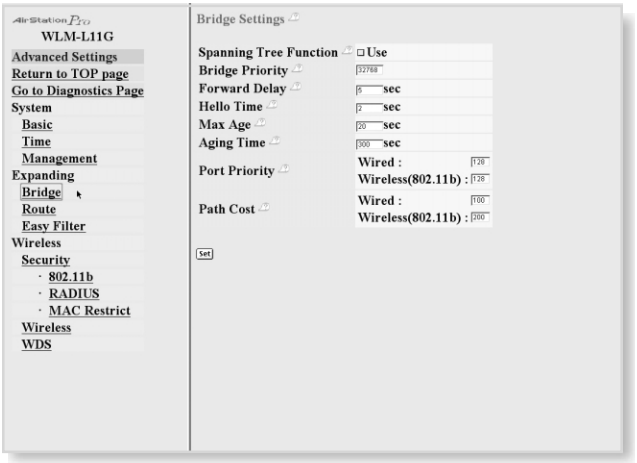


Figure 8.5 Bridge Settings

8.5.3 Forward Delay

Data forwarding can be delayed by a preset length of time. The delay time value may be from 4~30 seconds. The default value is 5 seconds.

8.5.4 "Hello" Time

The Hello message (to the network) broadcast time interval can be changed. The "Hello" message is used to set up network routing under the Spanning Tree protocol. The interval can be 1~10 seconds. The default value is 2 seconds.

8.5.5 Max Age

The "Hello" message time out period can be changed. The time out period starts the spanning tree elapse timing calculation once the "Hello" message signal reception has ceased. Once the Max Age time period is exhausted, the network topology will change.

8.5.6 Aging Time

Self-learned or registered MAC addresses that are not active will be erased after the Aging Time has elapsed. The value can be set anywhere from 10~1000000 seconds. The default value is 300 seconds.

8.5.7 Port Priority

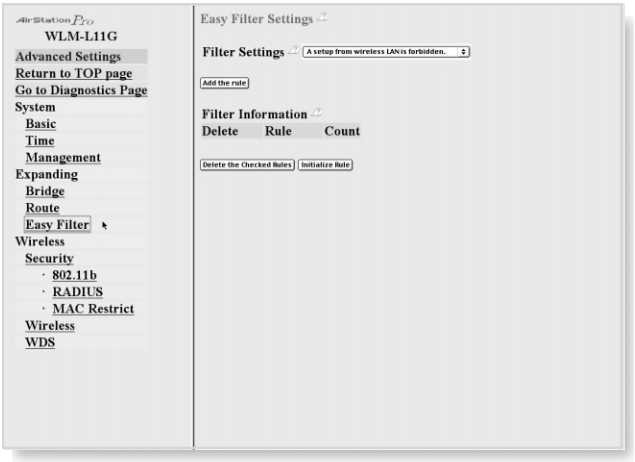
The priority of the STP port can be set from 0~255. Smaller values will have higher priority. The default value is 128.

8.5.8 Path Cost

The primary bridge owns a lower cost than the cost to other bridges so that the "Hello" message issued from the primary bridge automatically adds the cost to the message received from its parent bridge. The "Hello" message issued from a route bridge has 0 as the route path cost.

Figure 8.6
Route Settings

Figure 8.7
Filter Settings



8.6 Route Settings

Communication routing can be set between WLM-L11G and other network devices in the same network. The following parameters are supported:

RIP reception

Add Routing Table Entry

Routing Table Entries

8.6.1 RIP Reception

The RIP information received by the WLM-L11G can be set to RIP1, RIP2, RIP1 and RIP2, or no RIP. The default is both RIP1 and RIP2.

8.6.2 Add Routing Table Entry

Routing (or RIP) information can be set manually. The following parameters will be used. Destination address=The network IP address and the subnet mask for the destination. Gateway=The packet to the destination passes through the gateway address.

Metric=total number of routers to be passed before the packet reaches its destination. You can select from 1~15. The default value is 15. click "Add."

8.6.3 Routing Table Entries

Set routing information recognition and elimination. Check the item to be eliminated; then click "Delete Checked Items."

8.7 Easy Filter Settings

This is a simple filter for limiting access to the WLM-L11G.

8.7.1 Filter Settings

Four filters can be enabled by clicking "add the rule." They are:

- A setup from a wireless LAN is forbidden. This will prohibit access to the WLM-L11G's configuration screen from a wireless client.

- A setup from a wired LAN is forbidden. This will disable access to the configuration screens from a wired LAN PC.
- A setup over an AP is forbidden. This keeps anyone who is actually connected to a DIFFERENT AP from configuring the WLM-L11G.
- A request from a WLAN is ignored. Changes to the parameters (DHCP, DNS, etc.) are locked out. If you make a mistake here and "lock yourself out," the WLM-L11G can be returned to the factory default settings (ALL of them!) by holding down the INIT button on the back of the unit for 3 seconds.

8.7.2 Filter Information

Displays the current settings. To change a setting, check the box on the item to be changed and click "delete the checked rules." The setting can be reset to the default by clicking "Initialize Rule."

8.8 Security

Security features include Authentication, Privacy and Access Authorization.

8.8.1 Authentication 802.11b

Configure EAP authentication process. Configure EAP in the Security/802.11b screen.

■ Note: For MAC Access Restriction, do not check the "Enable" box until you have set up Authorized MAC addresses (Section 9.8.4.3).

8.8.2 Privacy, WEP Encryption Code

Set the encryption method used in wireless communications for the protection of your data. It is necessary that the WEP key match between two parties for secure communications. If multiple keys are used, the order must match between communicating devices. Examples of WEP key input are:

- 5 digits of ASCII characters. They are case sensitive and "_" is allowed, i.e. Skey5.
- 10 digits of hexadecimal numbers, i.e. a3d58b62fe.
- If WEP is not used, leave the box blank or input all 0s, which is equivalent to no-WEP.

8.8.3 Access Authorization, RADIUS

Set up RADIUS parameters. When a client requests communication with the WLM-L11G access point, the WLM-L11G reports its own MAC address to the RADIUS server and asks for communication approval to the client. Once the client is recognized by the RADIUS, the RADIUS issues a key to the AP as well as the client for initiation of communications.

Server Name=The name of the RADIUS server or the IP address.

Port Number=The port number to be used at the RADIUS upon approval. Some systems use 1645 as the default port number.

Shared Secret=The secret key to be used between the WLM-L11G and the client. It is the same key used between the RADIUS server and the AP for communication. Use numeral characters between 1~255.

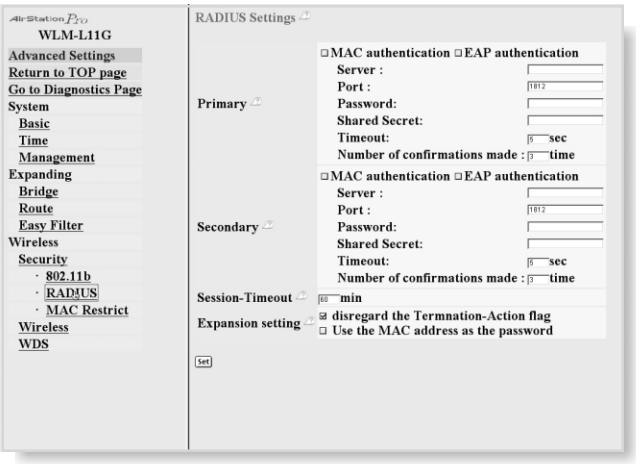


Figure 8.8.3 Access Authorization, RADIUS

8.8.4 MAC Restrict

Enable or disable access by MAC address through the wireless LAN network infrastructure mode.

8.8.4.1 Manual Setting

MAC addresses may be added to the authorized list manually. If RADIUS is enabled, the user must first be authenticated. Enter the MAC address in the "MAC address of wireless LAN PC" field and click "add." The MAC address must be in two-digit groups separated by colons. For example, 00:40:26:00:11:22.

Figure 8.8.4.1 Manual Setting

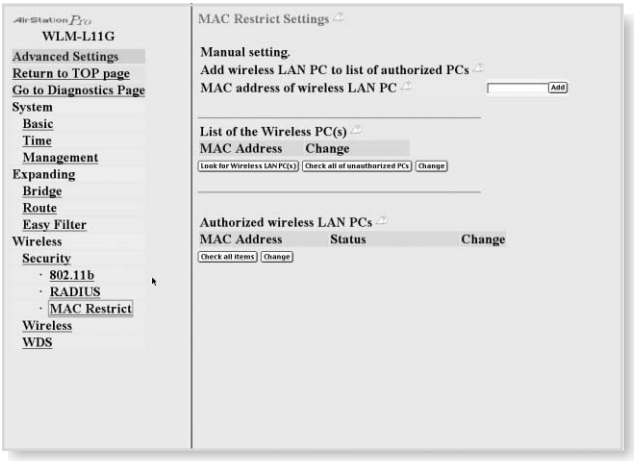
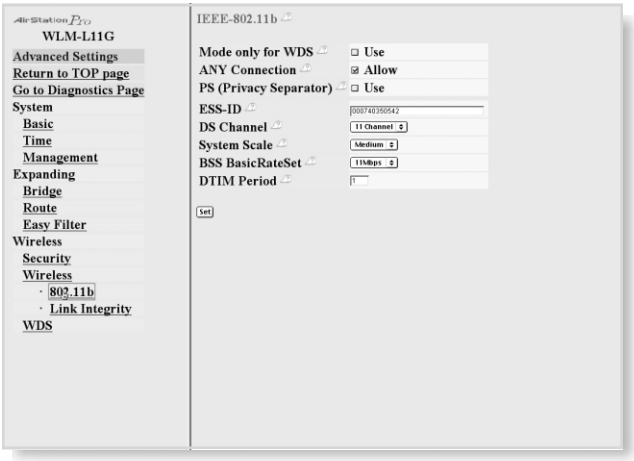


Figure 8.9 Wireless 802.11b



8.8.4.2 List of the Wireless PCs

Displays the PCs that are communicating with the WLM-L11G. Check the "registration" box and click the "change" button to add a MAC address.

8.8.4.3 Authorized Wireless LAN PCs

Displays all MAC addresses that are allowed to communicate with the WLM-L11G. The status shows the current active MAC addresses on the network. To eliminate a specific MAC address from the network, check the "delete" box and click the "change" button.

■ Note: If configuring from a wireless PC, add your MAC address to the list of authorized wireless LAN PCs (MAC restrict screen).

8.9 Wireless 802.11b

Wireless communication parameters and how to use them under the "IEEE802.11b" page. Setting some parameters will be equivalent to simple filtering. ANY connection, PS (Privacy Separator), ESS-ID, Wireless Channel, System Scale, BSS basic rate and DTIM Period are explained. WDS is explained in section 8.10.

8.9.1 ANY Connection

Allows a client PC to connect to the nearest WLM-L11G by manually entering the word "any" for the ESS-ID in the Client Manager. If the "ANY Connection" is deselected in the WLM-L11G, the WLM-L11G will not be found using the ESS-ID of "any" in the client PC.

8.9.2 PS - Privacy Separator

Enables automatic selection of the WLM-L11G with the least load within the roaming area. If PS is used, communications between wireless clients will be automatically blocked.

All clients are forced to go through the WLM-L11G and the system's combined security measures.

8.9.3 ESS-ID

Allows administrator to alter the ESS-ID of the AirStation. To communicate with a specific AP only, the AP's ESS-ID must be entered in the client computer. The client looks only for that specific AP (or ESS-ID) for wireless communication. Use up to 32 alphanumeric characters for the ESS-ID (case sensitive). Roaming is possible by setting identical ESS-IDs and WEP in WLM-L11Gs.

8.9.4 DS Channel (Wireless Channel Set)

The channel to be used for wireless communication. There are 11 channels.

■ Note: This is automatically set in the client computer.

8.9.5 System Scale (Roaming Area Scale)

Allows configuration of the roaming area around the WLM-L11G. If you experience difficulty in roaming, change to a Small or Mini setting, which will switch you to another WLM-L11G more quickly. This parameter can be used for balancing the load manually even though the load balancing is an automatic feature.

■ Note: The client wireless LAN card must support this feature.

8.9.6 BSS (Basic Service Set) Basic Rate

The transmission data rate between devices. If one device supports 2Mbps only, the data rate for the entire network will be limited to 2Mbps. Otherwise, use 11Mbps max.

8.9.7 DTIM Period

WLM-L11G transmits beacon signals to nearby clients in the preset interval. Once this option is used in the AP, the client must set the power management of the client card in order to control the beacon interval. Select a number from 1~255 sec. Selection of a larger number may save energy consumption, but it may delay wireless communication. The default value 1 recommended.

8.9.8 Link Integrity Settings

Link Integrity is a rerouting feature activated when the wired connection is lost.

8.9.8.1 Link Integrity

Enable or disable the Link Integrity feature.

8.9.8.2 Destination Host

Specify a host server name to which the WLM-L11G sends packets to confirm connection.

8.9.8.3 Interval of Checking Connection

Interval timer to check connection with destination host.

8.9.8.4 Retry Count

The number of times a retry will be attempted when a failed connection is detected. The retry is performed every 2 seconds.

8.9.8.5 Status

Link integrity status.

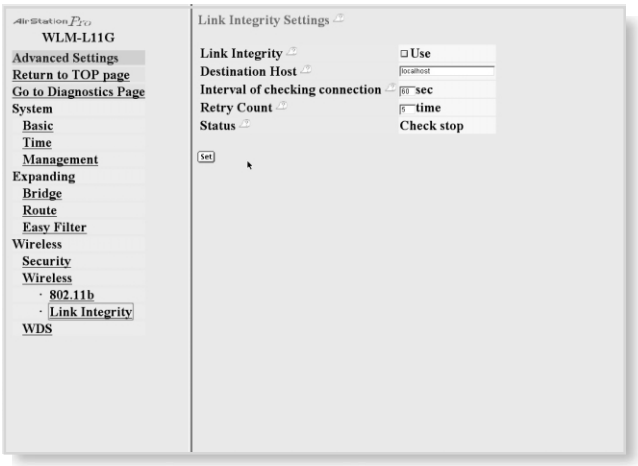


Figure 8.9.8 Link Integrity Settings

8.10 Wireless Distribution System Settings

WDS is used for wireless communication between access points. Allows the WLM-L11G to communicate with up to 6 other WLM-L11Gs. Since the communication method is proprietary and is not defined in Wi-Fi interoperable procedures, it communicates to WLM-L11Gs only, and not other brands of APs. The WDS setup is the same as repeater function setup.

- Add AirStation
- Connected AirStation

8.10.1 Add AirStation

The wireless LAN MAC addresses of all AirStations that will be communicating with each other have to be registered in each AirStation. Up to 6 AirStations can be registered in one AP. Input the MAC address in the two-digit format (00:40:26:00:11:22). Click "add" to register the MAC address. The added MAC address is checked in the "wireless MAC address" under the Diagnostic screen, on the Device Information page.

1. Open the Configuration Screen of the primary WLM-L11G, and go to the Advanced Settings screen
2. The User Name should be "root", and there is no password unless you have set one up on a previous configuration session.
3. Click on the WDS link at the bottom left side of the screen.
4. You will need the Wireless MAC address of the target WLM-L11G. Enter its MAC address in the field labeled "MAC Address of AirStation (Wireless)." Use the format XX:XX:XX:XX:XX:XX for the MAC address.
5. Click "Add." Repeat this process for up to 5 additional access points.
6. Once all of the MAC addresses are entered, repeat this process for each WLM-L11G you wish to set up for AP-AP communications. The second WLM-L11 must have the MAC address of the first one.

   Example: Suppose you wish to set up three units, #1 as a central unit, with #2 and #3 talking to #1, but not to each other. AP #1 would have the MAC addresses of both #2 and #3, as noted above, but #2 and #3 would only have the MAC address of #1.

8.10.2 Connected AirStation

All AirStations that are in communication (or ready to communicate) are seen by their MAC addresses along with the transmission rate mode. The data transmission rate modes are selected from Auto, 11Mbps, 5.5Mbps, 2Mbps and 1Mbps. To eliminate a certain MAC address, click "delete."

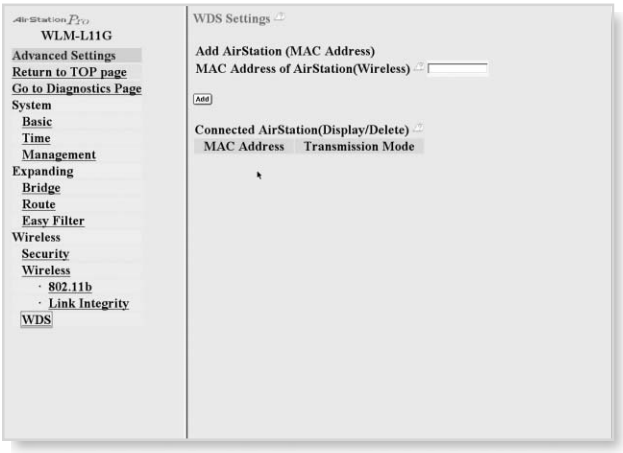


Figure 8.10 Wireless Distribution System Settings

PART IV

9.0 Diagnostics

9.1 Introduction IV

Diagnostics is a convenient tool for monitoring network operation and traffic.

9.2 Parameters for the Diagnostic Operation

The following parameters are used: Unit information, Packet information, Wireless LAN PC information, Ping testing, Log information and Setting initialization.

9.2.1 Unit Information

Parameters used in the WLM-L11G:

1. Model Name: The AirStation model name and firmware version number
2. AirStation Name: The alias for the AirStation
3. Wired Settings: WLM-L11G's wired MAC address
4. Wireless Firmware: The wireless LAN card model name and firmware version number
5. Wireless MAC address: WLM-L11G's wireless MAC address
6. Wireless Setting: Indicates wireless communication setting such as WDS mode, ANY connection, PS, ESS-ID, WEP, Channel and System Scale
7. IP address setup: Selection for setting the IP address. If auto IP address acquisition from the DHCP server is selected, the acquisition success or failed parameter will be shown.
8. Link Integrity: Indicates whether Link Integrity is working
9. Auto IP address acquisition: Acquisition of the IP address from the DHCP or update is performed.

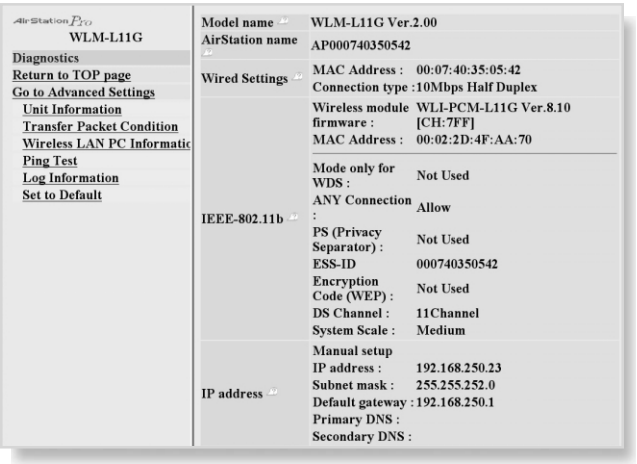


Figure 9.2.1 Unit information

9.2.2 Packet Information

Displays the actual packet volume used for wired and wireless communication. Packet volume for transmission receiving and their errors are shown separately.

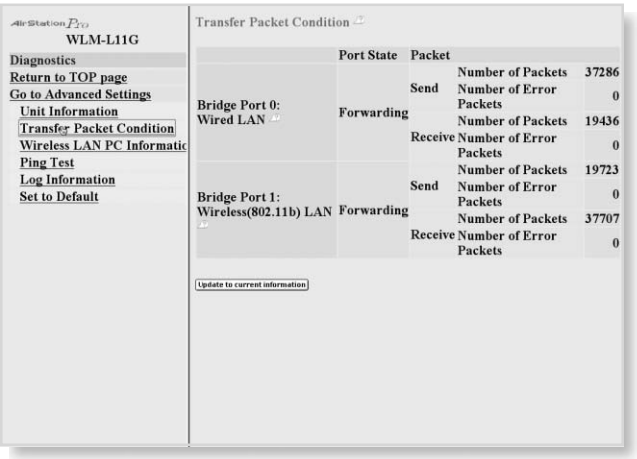
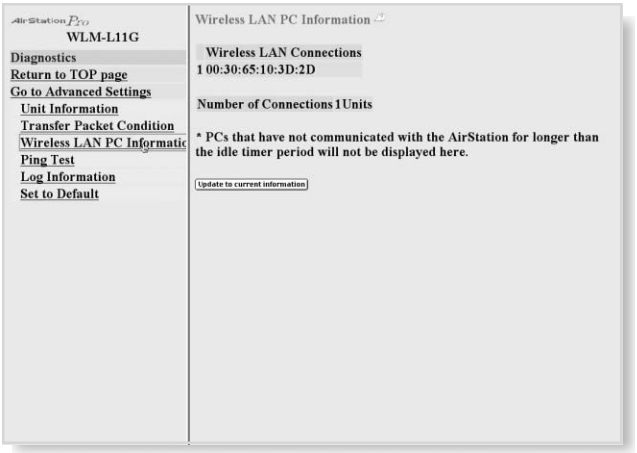


Figure 9.2.2 Packet information

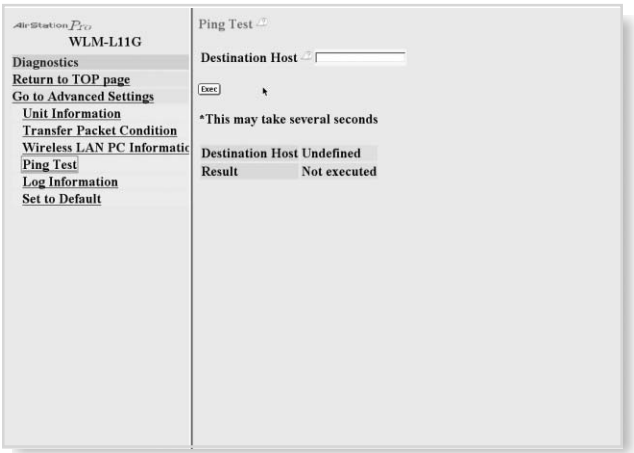
Figure 9.2.3
Wireless LAN
PC information



9.2.3 Wireless LAN PC Information

This information displays all PCs using the WLM-L11G wireless communication. The MAC addresses of communicating clients are shown. The information is updated periodically.

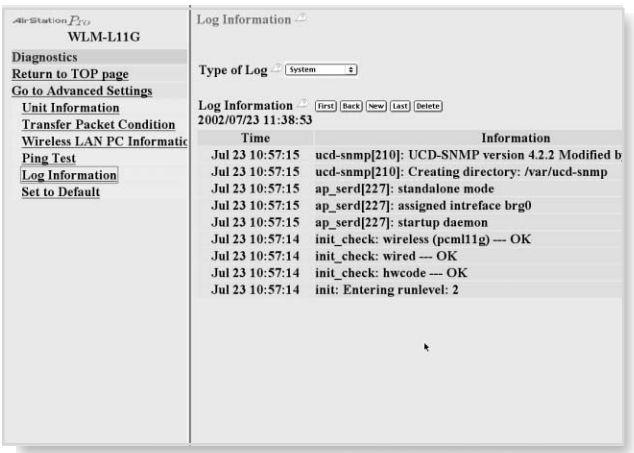
Figure 9.2.4
Ping Test



9.2.4 Ping Test

The WLM-L11G issues a ping test to the target PC in order for the AirStation to check the communication link. Input the target device's IP address and click "Exec."

Figure 9.2.5
Log
information



9.2.5 Log Information

Includes system operation, login approval, and wireless communication access approval. A log related to the setup history from a browser or Telnet session is recorded.

9.2.6 Setting Initialization - Set to Default

Allows the user to reinitialize all parameters back to factory defaults. After the reinitialization, the system will restart automatically.

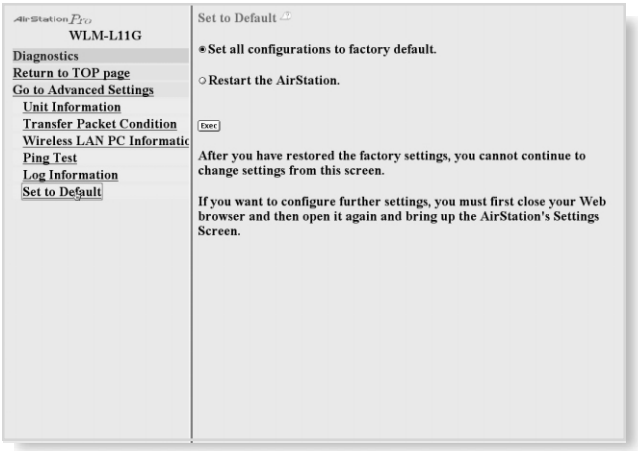


Figure 9.2.6

Additional Information

For more information, please consult one of the following:

- The on-line help system of your AirStation wireless system - for information about software and driver functionality.
- The AirStation web site at: http://www.buffalotech.com - for frequently asked questions (FAQ's) and Software Updates.

Appendix A

Range Information

- The range of your wireless devices can be affected when the AirStation is placed near metal surfaces and solid high-density materials.
- Range is also impacted due to "obstacles" in the signal path of the radio that may either absorb or reflect the wireless signal.

Appendix A - Intelligent Access Point (WLM-L11G) Specifications

Frequency Band	2.4GHz channel support
Operating Channels	11 channels (FCC); 20 MHz BW
	1:2412, 2:2417, 3:2422, 4:2427, 5:2432, 6:2437, 7:2442, 8:2447, 9:2452, 10:2457, 11:2462
Standards	IEEE 802.11b, IEEE 802.3 (10BASE-T), IEEE 802.1x/EAP, Wi-Fi
Data Rates Supported	11Mbps Fallback to 5.5, 2 and 1
	11Mbps – CCK modulation with Baker Code
	5.5Mbps – DQPSK modulation
	2 and 1 Mbps – DBPSK modulation
Typical Range at 1 Mbps	Outdoor: 550m (1804 ft); Indoor: 115m (377 ft) (*)
Typical Range at 2 Mbps	Outdoor: 400m (1312 ft);
	Indoor: 90m (295 ft) – Max
	40m (130ft) – Normal (*)
Typical Range at 5.5 Mbps	Outdoor: 300m (960 ft);
	Indoor: 35m (115 ft) (*)
Typical Range at 11 Mbps	Outdoor: 160m (525 ft);
	Indoor: 50m (164 ft) – Max
	25m (82 ft) – Normal (*)
Interface	NDIS 5.0 Miniport Driver
Supporting OS	Windows 9x, ME, 2k, XP
Bit Error Rate	Less than 10-5
Antenna	Integrated & capable to connect Buffalo indoor & outdoor antennas
Interface	10/100BASE-T
WAN – Protocols	TCP/IP, IPX/SPX, NetBEUI, DHCP
Media Access Protocol	CSMA/CA with ACK
Status Indicators (LED)	Power, Ethernet activity, Wireless Activity, Diagnostics
Encryption/Security	IEEE802.1x/EAP, WEP 40 bit or 128 bit, RC 4 algorithm, MAC address Monitoring/Filtering, ESS-ID, Password
Receive Sensitivity	-83 dBm~-94 dBm depending on the data rate
Delay Spread	65 ns~500 ns depending on the data rate
Output Power	30 mW 15dBm, 1.2 A nominal and 0.16A PoE
Power Supply	Power over Ethernet 48VDC over 10Base-T cabling (from PowerBASE-T module), or 5V DC
Radio/Electromagnetic Conformance Complacence	ETS 300 328, ETS 300 826, CE, EMV to EN 6060) (medical environment), FCC Part 15 B
Temperature & Humidity	0~60° C operational, -20~75° C Storage, 95% (no condensation)
Dimensions	W169 x H46 x L195mm
Weight	620g

Appendix B - Troubleshooting

This appendix is divided into following sections with each with it's own specific troubleshooting tips:

- LED Activity on section B.1.
- Other Problems on section B.2.

B.1 LED Activity

- Power LED should be GREEN
- Wireless LED should be GREEN if the line is active. If is it blinking GREEN, wireless communication is in use.
- Ethernet LED should be GREEN (100Mbps) or AMBER (10Mbps) while the communication is in use.

TABLE B.1 DIAG LED Activity Table

DIAG

LED Display	Time	Description/Action
Continuous Red	Starting	RAM Error
Red flash, 2 times	Starting	Flash ROM Error
Red flash, 3 times	Starting	problem in wired LAN side
Red flash, 4 times	Starting	problem in wireless LAN side
Red flash, 2 times	After setup completed	Flash ROM Error
Red flash, 2 times	During firmware update	Flash ROM Error

B. 2 Other Problems

- Out of range, which prevents the AirStation Client from establishing a wireless connection with the network.
- Configuration mismatch, which prevents the AirStation Client from establishing a wireless connection with the network
- Absence or conflict of the AirStation Driver in the client PC.
- Conflict of the AirStation hardware with another device.

For more information, please visit www.buffalotech.com.

GLOSSARY

10BaseT or 100BaseTx: 802.3 based Ethernet network that uses UTP (Unshielded twisted pair) cable and a star topology. 10 is 10 Mbps and 100 is 100 Mbps.

802.1x: The standard for wireless LAN authentication used between an AP and a client. 802.1x with EAP will initiate key handling.

AdHoc Network: The wireless network based on peer-to-peer for the duration of a communications session. Also referred to as Ad-Hoc.

Address Aging Period: The maximum time during which the forwarding database entries are considered valid. This value should be set low if your network has regularly heavy traffic. Each new device that sends a packet to a device has its MAC address added to the System Forwarding Database. The Database can store up to a maximum of 8192 MAC addresses at any one time. After the maximum number of MAC addresses has been reached, the earliest stored addresses are overwritten with new, incoming information.

AES (Advanced Encryption Standard): A symmetric 128bit block data encryption technique used for security.

Bandwidth: The transmission capacity of a computer, or a communication channel, stated in Megabits per second (Mbps).

BOOTP: Software protocol used by servers. When the client PC starts, it contacts the server, and requests a new set of IP Configurations. The server obtains the new IP Configuration information from a static pool of available addresses. The client PC will keep its IP Configuration information until it is turned off and restarted. BOOTP is not always fully supported in newer operating systems.

BNC (British Naval Connector): A BNC connector has a bayonet-type shell with two small knobs on the female connector, which

twist-lock into slots in the male connector. Used with coaxial cable.

BSS (Basic Service Set): An 802.11 networking framework that includes an Access Point.

Bus Mastering: A system in which the specified Input/Output device (e.g., NIC Card) can perform tasks without the intervention of the CPU.

Client: A PC or a workstation on a network.

CRC (Cyclic Redundancy Check): Calculation method used to check the accuracy of a digital transmission over a communications link.

Cross-Over Wiring: A UTP cable that has its transmit and receive wires crossed to allow communications between two devices.

DCE (Data Communications Equipment): Hardware to be used for communication with a Data Terminal Equipment (DTE) device

Default Gateway: The IP Address of either the nearest router for the LAN or server for the LAN.

Default Parameter: Parameters set by the manufacturer.

Destination Address: The address portion of a packet that identifies the intended recipient station.

DHCP (Dynamic Host Configuration Protocol): Based on BOOTP, it uses a pool of IP addresses, which it gives out to each device connected to it, and retrieves the addresses when the devices become dormant for a period of time.

DNS (Domain Name System): The on-line distributed database system used to map human-readable machine names into IP addresses. DNS servers throughout the connected Internet implement a hierarchical namespace that allows sites freedom in assigning machine names and addresses. DNS also supports separate mappings between mail destinations and IP addresses.

Driver: A software program that tells an operating system how to use a hardware device.

DSSS (Direct Sequence Spread Spectrum): A method that spreads the wireless signal into wide frequency bandwidth.

DTE (Data Terminal Equipment): Device that controls data flowing to or from a computer.

Dynamic IP Address: An IP address that is automatically assigned to a client station in a TCP/IP network, typically by a DHCP server.

ESS (Extended Service Set): A set of two or more BSSs that form a single sub-network. ESS-ID is user identification to be used in the ESS LAN configuration.

Ethernet: The most widely used architecture for Local Area Networks (LANs). It is a shared media network architecture.

Ethernet cable: A wire similar to telephone cable that carries the signals between Ethernet devices.

File and Print Sharing: An application supplied by Microsoft that allows the computers on a network to share files and printers.

Firmware: Programming that is inserted into programmable read-only memory, thus becoming a permanent part of a computing device.

Frame: A frame includes: the data packet, the destination device's address, source device's address, the length of the data packet, and error checking information.

Full-Duplex: Capability for simultaneous transmission in both directions, allowing devices to send & receive data at the same time.

Gbps (Gigabits per second): A measurement of billions of bits per second.

Half-duplex: To transmit on the same channel in both directions, one direction at a time.

Hub: A device which allows connection of computers and other devices to form a LAN. When a hub receives packets from a computer or other device, it repeats the packets to all of the devices connected to its ports.

IEEE (Institute of Electrical and Electronics Engineers): The professional organization which promotes development of electronics technology.

IP (Internet Protocol) Address: A unique 32-binary digit number assigned by an Internet authority that identifies each sender or receiver of information that is sent in packets across the Internet or Intranet.

Infrastructure: A wireless network or other small network in which the wireless network devices are made a part of the network through the Access Point.

ISP (Internet Service Provider): A company that provides access to the Internet and related services.

IV (Initialization Vector): The header section of a message packet.

LAN (Local Area Network): A group of computers and peripheral devices connected to share resources

LED (Light Emitting Diode): The lights on a hardware device representing the activity through the ports.

MAC (Medium Access Control) Address: The physical address of a network node.

Mbps (Mega Bits Per Second): A measurement of millions of bits per second.

MHz (Mega Hertz): A measurement of millions of cycles per second.

MIB (Management Information Base): An internal database of commands and data structures used to define and profile the capabilities of the device for which it was written.

MIC (Message Integrity Check): A method of using a checksum to ensure a data message is not altered by a third party.

MIPS (Millions of Instructions Per Second): A measurement of processing speed.

NAT (Network Address Translation): An Internet standard that enables a LAN to use one set of IP addresses for internal traffic and a second set of addresses for external traffic.

NIC (Network Interface Card): An expansion board inserted into a computer so the computer can be connected to a network.

Packet: A block of data that is transferred as a single unit; also called a frame or a block.

Packet Filtering: Discarding unwanted network traffic based on its originating address or its type.

PCI (Peripheral Component Interconnect): A bus that is connected directly with the CPU.

PCMCIA (Personal Computer Memory Card International Association) Card: A PC card suitable for several types of applications.

Ping (Packet Internet Groper): An Internet utility used to determine whether a particular IP address is online.

Plug and Play: Hardware that, once installed ("plugged in"), can immediately be used ("played"), as opposed to hardware that requires manual configuration.

PoE (Power over Ethernet): A mechanism to send DC power to a device using a CAT5 Ethernet cable.

PPPoE (Point-to-Point Tunneling Protocol): A specification for connecting users on an ethernet line to the internet through a common broadband medium.

Protocol: A standard way of exchanging information between computers.

RADIUS (Remote Authentication Dial In User Service): A server that issues authentication keys to clients.

RAM (Random Access Memory): Non permanent memory.

Repeater Hub: A device that collects, strengthens and transmits information to all connected devices, allowing the network to be extended to accommodate additional workstations.

RC4: The encryption algorithm that is used in WEP

RJ-45 connector: An 8-pin connector used for connecting twisted pair cable to a data transmissions device.

ROM (Read Only Memory): Permanent memory.

Router: A device that can connect individual LANs and remote sites to a server.

Roaming: The ability to use a wireless device and be able to move from one access point to another without losing the connection.

Script: A macro or batch file that contains instructions that the computer executes to perform a task.

Server: Any computer that makes access to files or peripheral devices available to users of the network.

SMTP (Simple Mail Transfer Protocol): The protocol used to define and deliver electronic mail (e-mail) from one server to another.

SNMP (Simple Network Management Protocol): An application layer protocol that outlines the formal structure for communication among network devices.

Static IP Address: Also known as a global IP. A permanent IP address that is assigned to a node in a TCP/IP network.

STP (Shielded Twisted Pair): See Twisted Pair.

Subnet Mask: An eight byte address divided into 4 parts grouped by periods.

TCP/IP (Transmission Control Protocol/Internet Protocol): The protocol used by computers when they communicate across the Internet or Intranets.

TFTP (Trivial File Transfer Protocol): Simple form of FTP (File Transfer Protocol). Uses UDP (User Datagram Protocol) and provides no security features.

TKIP (Temporal Key Integrity Protocol): An encryption method replacing WEP. TKIP uses random IV and frequent key exchanges.

Topology: The shape of a LAN (Local Area Network) or other communications system.

Twisted Pair: Cable that comprises 2 or more pairs of insulated wires twisted together

UDP (User Datagram Protocol): A communication method (protocol) that offers a limited amount of service when messages are exchanged between computers in a network. UDP is used alternatively to TCP/IP.

Uplink: Links to the next level up in the herarchy of a network.

UTP (Unshielded Twisted Pair) cable: A standard UTP cable has straight-through wiring. See Twisted Pair.

WAN (Wide Area Network): A networking system that covers a wide geographical area.

WDS (Wireless Distribution System): A method for an AP to communicate with another AP. This method is powerful for point-to-point or point-to-multipoint infrastructure.

WEP (Wired Equivalent Privacy): An encryption method based on 64 or 128bit algorithm.

Web Browser: A software program that allows the user to view Internet pages.

Wi-Fi (Wireless Fidelity): An organization that tests and assures interoperability among WLAN devices.

Wire Speed: The maximum speed that a given packet can be transferred using Ethernet and Fast Ethernet standard specifications.

WLAN (Wireless LAN): A LAN topology using wireless devices.

VPN (Virtual Private Network): A security method to connect remote LAN users to their corporate LAN system.